

**Institutional Frameworks Case Study
Barber Orchard, Waynesville, North Carolina**

1.0 Introduction/Summary

Barber Orchard is a 500-acre former apple orchard in western North Carolina that has been partially developed into residential housing. Past application of pesticides, spills in pesticide mixing areas, and leaks of an underground distribution system for pesticides have contaminated soils and ground water at the former orchard with a variety of chemicals, including lead, arsenic, and organic pesticides in soils and benzene hexachloride (BHC) in ground water. After a resident requested sampling of a private well in 1999, the State of North Carolina, and later Haywood County and the Environmental Protection Agency (EPA), conducted several sampling efforts at the site. In response to potential health risks posed by historical pesticide contamination at Barber Orchard, EPA conducted emergency soil removal at 28 residences where arsenic levels exceeded 40 parts per million (ppm). The State of North Carolina and Haywood County recommended that residents filter their drinking water and take precautions to avoid exposure to contaminated soils. EPA completed the emergency removal action in August 2000 and listed the Barber Orchard site on the Superfund National Priorities List (NPL) in 2001. EPA is currently conducting a Remedial Investigation/Feasibility Study of the former orchard to determine what should be done to address the remaining contamination at the site, including areas that have not been developed into residential housing.

The remainder of this case study is organized as follows.

- Section 2 provides background on the site, the sources of contamination, key players, and a chronology of major milestones.
- Section 3 describes how contamination problems were identified and addressed.
- Section 4 discusses the protective measures that have been considered and selected to address the contamination.
- Section 5 outlines funding sources and legal authorities employed.
- Section 6 discusses lessons learned from problem assessment and the implementation of protective measures.
- Section 7 lists references consulted for the case study.

2.0 Background

2.1 Site Description

Barber Orchard is an approximately 500-acre site located three miles west of Waynesville, North Carolina. The property is on a hillside with elevations ranging from about 3,000 feet along Richland Creek to more than 4,000 feet along U.S. highway 74. Barber Orchard operated as a commercial apple orchard from about 1908 to 1988, when the orchard went bankrupt. At that point, the property was sold to a developer, subdivided, and partially developed into residential housing. Apples are still grown on a portion of the property.

Most of the homes on Barber Orchard were built during 1993–94, but a large portion of the property remains undeveloped. There are about 90 homes and about 300 undeveloped lots in

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the housing subdivision. Home values range from \$200,000 to \$500,000. The lots range in size from less than an acre to more than 20 acres in size. For many of the residents, the homes at Barber Orchard are summer residences only.

2.2 Sources of Contamination

Because of its hillside location, the commercial orchard had an unusual distribution system for pesticides—a pressurized underground piping system delivered pesticides to various locations on the property, where orchard employees would connect a flexible hose and nozzle to the pipeline to apply the pesticides. Pesticides were stored in a packinghouse on the property and mixed in two 500-gallon concrete tanks in a central mixing area. The pesticide distribution system, which was buried at a depth of one foot, was routinely flushed to prevent clogging, and during winter months the pipes would rupture and freeze. Pesticides, fungicides, and rodenticides used at the orchard included lead arsenate, dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethane (DDD), benzene hexachloride (BHC), endrin, and dieldrin. Leakage of the pesticide distribution system, spills from mixing pesticides, and product application on apple trees have resulted in soil and ground water contamination on the property.

2.3 Key Players and Roles

Organizations involved in the assessment and remediation of contamination at Barber Orchard include the following.

- The Haywood County Health Department helped sample well water at Barber Orchard, hosted the first public meeting about the contamination, recommended individual protection measures for residents, assisted residents in studying the effectiveness of drinking water filters, is arranging for the Barber Orchard subdivision to be connected to a municipal water supply, and notifies property owners who are about to build on land at other former orchard areas about the potential for pesticide contamination.
- The North Carolina Department of Environment and Natural Resources Division of Water Quality initially sampled water in private wells at Barber Orchard along with the Haywood County Health Department and notified the EPA about the contamination.
- The North Carolina Department of Agriculture and Consumer Affairs conducted the initial soil sampling at Barber Orchard.
- The North Carolina Department of Health and Human Services issued health advisories to residents after contamination was discovered.
- The Environmental Protection Agency Region 4 sampled soils and ground water at Barber Orchard after the State of North Carolina and Haywood County had conducted sampling earlier, hosted public meetings for local residents, conducted an emergency removal action for developed areas of existing residential properties, listed Barber Orchard on the Superfund NPL, and is developing a Remedial Investigation/Feasibility Study to determine whether and what kind of additional cleanup is needed at the site.
- The U.S. Agency for Toxic Substances and Disease Registry conducted a Public Health Assessment for Barber Orchard after EPA completed its emergency removal action at Barber Orchard and proposed to list the site on the Superfund NPL.

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2.4 Chronology of Major Milestones

Date	Activity
1908–88	▪ Commercial apple orchard operates at Barber Orchard.
1988–89	▪ Orchard goes bankrupt; land is parceled off and sold for residential development.
1993–94	▪ Most of the homes in Barber Orchard subdivision are built.
1999	<ul style="list-style-type: none">▪ Resident asks NCDENR Division of Water Quality to test well water, and organic pesticides are detected in the water in January.▪ NCDENR Division of Water Quality and Haywood County sample 88 wells.▪ North Carolina Department of Agriculture and Consumer Affairs samples soils and finds elevated levels of arsenic, lead, and other pesticides.▪ EPA Region 4 collects soil and ground water samples, provides bottled water to one resident, and initiates a time-critical removal action in June.
1999–2000	▪ EPA removes 31,500 tons of arsenic-contaminated soil from 28 residential properties and replaces soil with clean fill.
2001	<ul style="list-style-type: none">▪ EPA places Barber Orchard on Superfund National Priorities List.▪ EPA approves Work Plan for Remedial Investigation/Feasibility Study.
2002	▪ The Agency for Toxic Substances and Disease Registry releases Public Health Assessment for Barber Orchard for public comment.

3.0 Problem Assessment

3.1 Discovery of Contamination

In January 1999, on the advice of a former orchard worker, a resident of the Barber Orchard subdivision asked the North Carolina Department of Environment and Natural Resources (NCDENR) Division of Water Quality to test the resident's well water for the possible presence of pesticides. The NCDENR Division of Water Quality detected BHC in the water and notified the Haywood County Health Department that the State toxicologist would be evaluating the results. The State toxicologist recommended that the resident not drink the water but drink bottled water (which was not provided) instead. This recommendation initiated a larger sampling effort by the NCDENR Division of Water Quality and the County Health Department. Of the 88 wells these agencies sampled, 34 contained total BHC concentrations above the State standard of 0.019 parts per billion (ppb).

In addition to the ground-water sampling, the North Carolina Department of Agriculture and Consumer Affairs sampled the soils on 16 properties at Barber Orchard and found that concentrations of arsenic, lead, and some pesticides exceeded the State of North Carolina Inactive Hazardous Sites Program's soil remediation goals (400 parts ppm for lead and 4.4 ppm for arsenic).

3.2 Further Investigation of Soil and Ground-Water Contamination

The State of North Carolina forwarded the results of the ground-water and soil sampling to EPA Region 4, which initiated another sampling effort at Barber Orchard in June of 1999. The Region 4 Science and Ecosystem Support Division collected soil samples from 55 properties (53 of which were residential) and ground-water samples from 55 private wells at Barber Orchard. EPA found arsenic soil concentrations above 20 ppm at 35 properties; of those

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properties, 25 had arsenic concentrations above 40 ppm. EPA Region 4 established an emergency response level of 40 ppm of arsenic in soil for developed residential areas at Barber Orchard.¹ In addition, 21 of the wells sampled had concentrations of BHC and other pesticides that exceeded EPA health-based benchmarks. Neither arsenic nor lead was detected in ground water.

To address potential health risks from this contamination, EPA initiated an emergency removal action at Barber Orchard in 1999 and listed the site on the Superfund National Priorities List in 2001 (protective measures used at Barber Orchard are discussed below). EPA is currently conducting additional sampling at Barber Orchard as part of a Remedial Investigation/Feasibility Study (RI/FS) for the site. The following table summarizes initial soil sampling results for arsenic and lead, which are among the contaminants of concern at Barber Orchard, and associated cleanup levels for the site.

Arsenic and Lead Soil Concentrations and Cleanup Levels at Barber Orchard

Contaminant	Concentration Range (ppm)	Frequency of Detection / Total	EPA Region 4 Emergency Response Level (ppm)	EPA Remedial Level (ppm)	NC Soil Remediation Goal (ppm)
Arsenic	ND* – 1,340	210 / 273	40	20	4.4
Lead	ND* – 3,090	273 / 273	400	400	400

*Not detectable. Since there were hot spots of arsenic and lead concentrations all over the former orchard, EPA and ATSDR have not been using average concentrations to evaluate potential health risks.

3.3 Public Health Assessment

After EPA proposed listing Barber Orchard on the National Priorities List, the Agency for Toxic Substances and Disease Registry (ATSDR) prepared a draft Public Health Assessment for Barber Orchard, which it released for public comment in April 2002. As part of this health assessment, which occurred *after* EPA conducted its emergency removal action at Barber Orchard, ATSDR sampled the urine and blood of residents living at 29 properties that had previously had high levels of arsenic and lead in soil and observed no health effects. In the draft Public Health Assessment, ATSDR concludes, “current exposures to site contaminants are not likely to result in adverse health effects,” but reports that, in the past, residents who drank well water with the highest levels of pesticides and children who were exposed to soil with the highest levels of arsenic and lead may have increased their risk of adverse health effects. ATSDR’s conclusions about current health risks to Barber Orchard take into account that residents are filtering their water to remove contaminants and that EPA has cleaned up frequently used areas of residential yards that had higher levels of arsenic and lead.

¹ The emergency response level is based on the potential for imminent and substantial threat to human health or the environment. EPA Region 4 calculates the emergency response level on a site-specific basis, but has often used 40 ppm as the emergency response level for arsenic in residential areas.

4.0 Protective Measures

4.1 *Selection of Protective Measures*

Since pesticide contamination was detected at Barber Orchard, the EPA and Haywood County have taken several short-term precautions to reduce contaminant levels and control exposures. They are now developing long-term strategies for protecting human health and the environment at the site. EPA has provided bottled water to one residence, conducted an emergency soil removal at the developed areas of 28 residential properties, and listed Barber Orchard on the National Priorities List so that the site will be further investigated and remediated. The Haywood County Health Department has focused instead on informing current and future residents about pesticide contamination and the risks of exposure, encouraging residents to use water filters for private wells and to test soils at new developments, and connecting Barber Orchard to a municipal water supply.

For the Remedial Investigation/Feasibility Study (RI/FS), EPA will be collecting samples from soil, sediment, ground water, and surface water at Barber Orchard to more fully characterize the nature and extent of contamination, focusing on areas not sampled during the emergency soil removal. Alternatives for remediating soil and ground-water contamination at Barber Orchard—including alternatives to reduce the toxicity, mobility, or volume of waste; containment with little or no treatment, and a no-action alternative—will also be analyzed and screened. EPA expects the RI/FS to be completed by June 2002 and the Record of Decision to be issued for Barber Orchard by December 2002.

Details about protective measures used and planned at Barber Orchard are discussed below.

4.2 *Removal of Contaminants*

Soil Removal and Replacement

When EPA detected concentrations of arsenic in soil above 40 ppm—EPA Region 4's short-term exposure cleanup criterion—it initiated an emergency removal action at Barber Orchard. From September 1999 to August 2000, EPA Region 4's Emergency Response and Removal Branch excavated the top foot of soil from the yards of 28 residential properties where residents currently lived. In the emergency response, EPA only excavated and replaced contaminated soil from the developed areas of the residential yards (e.g., where grass was established) not the entire properties. In addition, EPA removed and replaced soil at a former pesticide mixing area. Because higher lead levels were associated with areas of higher arsenic levels at Barber Orchard, the emergency removal for arsenic soil contamination also addressed short-term risks from exposure to lead-contaminated soil. The emergency soil removal involved excavating, transporting, and disposing 31,500 tons of contaminated soil to a landfill in Georgia, replacing the contaminated soil with clean soil, and seeding the new soils at residences.

Drinking Water Protections

When EPA found lindane (gamma-BHC) levels in one well that exceeded EPA Region 4's removal action limit of 2 ppb, it provided the residence with bottled water. After initially recommending that residents not cook or drink water from private wells, the Haywood County Health Department recommended that residents use carbon filters to remove contaminants from well water and test the water every six months to ensure that filters continue to operate properly. Most residents have installed at least a paper filter for their water. As a long-term strategy,

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Haywood County is installing a 3.5-mile water line with two pump stations and holding tanks to serve current and future residents of Barber Orchard. After it is installed, the Town of Waynesville will take over ownership of the first 2.5 miles of the water line and the County will own the last mile and the pump stations.

4.3 *Education and Outreach*

Public Notices and Public Meetings

While the initial sampling was occurring, the Haywood County Health Department and the North Carolina Department of Health and Human Services notified Barber Orchard residents of potential health risks and recommended that residents avoid contact with soil around their homes and not use water from private wells for drinking or cooking without filtering it first. In addition to issuing public notices, the Haywood County Health Department distributed ATSDR fact sheets to residents about arsenic, lead, and other chemicals of concern at Barber Orchard and hosted a public meeting for residents after the County and the NCDENR Division of Water Quality had sampled about 20 private wells. Since that initial outreach, EPA has led the education and outreach activities for Barber Orchard, including hosting additional public meetings to inform residents and answer questions about sampling and cleanup activities. Initial public meetings were well attended and received considerable media attention, but few people attend public meetings now that the emergency removal action has been completed.

Notification to Property Owners Applying for Permits

For future homes built on former orchard land (including Barber Orchard and other orchards in Haywood County), Haywood County notifies property owners who apply to the County for improvement permits for septic tanks (when the County first gets involved in the development process) that there may be pesticide residues on their properties and that they may want to have their soils and ground water tested. Since homes located more than a mile outside of cities need septic tanks, this means that, in effect, Haywood County is able to notify all property owners who are about to build on land (but not people about to *buy* land²) at former orchards about the potential for pesticide contamination.

4.4 *Other Protective Measures Being Considered*

As mentioned earlier, EPA is currently conducting a Remedial Investigation/Feasibility Study to determine long-term remedies for the remaining contamination in developed and undeveloped areas of the Barber Orchard site. EPA expects that these protective measures probably will include the removal of the underground piping system used to distribute pesticides and some type of land-use control to ensure that undeveloped areas with particularly high contamination levels do not become residential housing.

² No government agency or private institution in Haywood County currently provides notification at the time of purchase about the potential for pesticide contamination.

5.0 Funding and Legal Authorities

5.1 Funding Sources and Mechanisms

EPA, the State of North Carolina, and Haywood County have shared the costs for soil and ground-water sampling, public meetings, and community outreach activities at Barber Orchard.

EPA's costs for the emergency soil removal and related sampling were about \$4 million. EPA will pay about \$980,000 for the RI/FS. EPA estimates that the total cost of cleanup of the Barber Orchard site will be \$10 million, of which the State of North Carolina is required to pay 10 percent. EPA's funding is from the Superfund Trust fund, and EPA has made a commitment that it will not ask for reimbursement from any homeowners at Barber Orchard.

Property owners pay for any water filters and/or additional testing or monitoring of their drinking water.

The 3.5-mile water line with pump stations and holding tanks that Haywood County is building to serve Barber Orchard residents is a \$2.5–3 million project paid largely through grants. NCDENR provided the majority of the money for the project in a \$1.6 million grant to Haywood County, while EPA and the North Carolina Rural Economic Development gave the County grants of \$475,000 and \$350,000 respectively.

5.2 Legal Authorities

EPA's authority is derived from the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) and the Superfund Amendments and Reauthorization Act (SARA). EPA Region 4 conducted the emergency soil removal at Barber Orchard as a short-term cleanup to address contamination that posed an "imminent and substantial threat" to human health or the environment. Barber Orchard is one of the first orchard sites EPA has listed on the Superfund National Priorities List, because EPA has a general policy against listing sites with contamination resulting solely from the legal application of pesticides. Typically, EPA only lists sites with pesticide residues if the contamination can be attributed to leaks, spills, or improper disposal of the pesticides.

6.0 Lessons Learned

There has been a relatively short history of investigation and cleanup at Barber Orchard since contamination was first discovered in 1999. Only a portion of the former orchard has been remediated, largely through EPA's emergency removal in 1999–2000, and EPA has yet to issue a Record of Decision outlining plans for the final remediation of the Barber Orchard site. As such, the following are preliminary lessons learned from the first stage of cleanup at the site.

6.1 What Worked Well

Providing Information to Residents After Discovery of Contamination. After contamination was discovered, Haywood County, the State of North Carolina, and EPA provided information to Barber Orchard residents about contamination levels, potential health risks, and cleanup activities through a series of public meetings, fact sheets, and public notices. EPA is continuing public outreach and education as part of developing the RI/FS for Barber Orchard. Haywood

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County also continues to notify property owners when they apply for septic tank permits about the potential for pesticide contamination.

Cooperation of Property Owners Regarding Drinking Water Filters. Property owners cooperated with the Haywood County Health Department in testing and using carbon filters to remove contaminants from well water. The County's testing of the effectiveness of the filters, which were shown to be effective, did a great deal to relieve people's anxiety. Most property owners at Barber Orchard have purchased and now use water filters for their wells.

6.2 *What Did Not Work Well (or Challenges Being Faced)*

Reaction of Lending Institutions. After contamination was discovered at the Barber Orchard subdivision and Haywood County held the first public meeting about it, appraisers refused to appraise properties and lending institutions would not give out a mortgage or second mortgage for properties at Barber Orchard. Lending institutions are now reconsidering the informal moratorium they placed on mortgages, and some institutions may have abandoned it already.

Unclear Effects on Property Values. There have been cash sales of undeveloped properties at Barber Orchard since 1999, but these sales reportedly have been for less value than undeveloped properties sold for previously. On the other hand, homeowners at the Barber Orchard subdivision have apparently re-sold their homes and obtained their asking prices. Property owners at Barber Orchard have requested that the County Tax Assessor's Office reduce the assessed values of properties for property tax purposes because of the contamination found at Barber Orchard and the Superfund NPL listing; the County has not taken action on those requests.

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